Forbearance Expectations and the Subordinated Debt Signal of Bank Insolvency

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Abstract

It has been proposed that bank subordinated debt yields be used as a signaling device to reflect a bank's condition. Of particular interest to those charged with the bank safety net is a reduction in the recognition lag of bank distress in order to promote self-correction by the bank or for the regulator to prevent costly forbearance of an insolvent bank. Using the Black and Cox contingent claims model for subordinated debt valuation, we relate the signaling device, the bank's subordinated debt yield, to the investors' view of the bank's solvency. The analytical solution to the model reveals that if investor's forbearance expectations were to be under the maximum of 270 days allowed under Prompt Corrective Action standards, subordinated debt yield spreads will generally anticipate the bank's insolvency. If investors hold longer forbearance expectations subordinated debt yield spreads fail to give an early warning of bank insolvency. Based on empirical estimates from bank subordinated debt observations over the latter half of the l990s, investor's expected forbearance exceeded 270 days so that subordinated debt yields did not likely provide early insolvency recognition. Our conclusion is that lengthy forbearance expectations prevail, despite a legislative mandate to the contrary, that prevents the subordinated debt signal from being effective and useful as a basis for insolvency detection or federal deposit insurance pricing.

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I. Introduction

Following the worst bank and thrift insolvencies of the late l980s and early 1990s since the great depression era, two cornerstones for the early reaction time to defend the bank insurance fund have emerged: the use of market prices of bank securities to provide an early recognition of an impending insolvency and a legislative mandate to quickly resolve insolvent banks known as Prompt Corrective Action (PCA). Underlying this approach is a presumption that an early market signal of an impending insolvency would pressure a bank to resolve its problems while still solvent (market discipline)[1] and if the problems were not corrected, the early signal would pressure the bank supervisor to deny forbearance to avoid high deposit insurance payouts that had prevailed in the past.[2]

Because early recognition of tangible insolvency through accounting data has proved to be problematic (Beaver, et. al. (1992) and White (1991)) proposals from both academic sources (Shadow Financial Regulatory Committee (2000) and Calomiris (1999)) and government sources (Basle (1999), Study Group on Subordinated Notes and Debentures (1999)) for the mandatory issuance of subordinated debt have emerged.[3] As a result of these recommendations, the Gramm-Leach-Bliley Act of l999 required that the 50 largest U.S. insured banking companies issue subordinated debt so that the secondary market prices of the subordinated debt might provide a real time signal of possible

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[1] See Study Group(1999) for a discussion of the cumulative pressures on the bank to discipline its risk taking. Bliss and Flannery (2000) for a discussion of the disciplinary effect of securities pricing. Numerous benefits have been cited that would derive from the market measure of bank solvency. First, it is thought that it would "discipline" banks from further risk taking by providing a signal that additional capital, downsizing or restructuring was required. If the discipline would not be self imposed, discipline would likely be imposed by other claimants and correspondents who would alter the terms of supplying credit to the banking institution and reduce the bank's ability to charge premium lending rates based on its prime reputation (Cook, Schellhorn and Spellman(2002)).

[2] Investor signals of bank solvency can derive from a number of priced claims though most studies have examined bank deposits, whether insured or uninsured (for example, Cook and Spellman(1996)), and subordinated debt (for example, Flannery and Sorescu (1996)). Recently there has been an expansion in the investigation of other market signals to include market microstructure variables such as bid-asked spreads, trading volume and volatility in the pricing of bank stock (Flannery, Kwan and Nimalendran (2000)).

[3] Accounting measures of bank market valued capital do not exist, but accounting measures of tangible capital for banking companies is readily available. Accounting is based on GAPP standards that are relatively slow to write-off bank assets and there is no active secondary market in most banks loans so that a market reading of the banks market value of assets is not possible on an on going basis.

problems. If the signal of bank insolvency is present, the intervention by the regulators contained in the PCA provisions of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) is to be triggered if the regulator believes the bank's tangible capital has deteriorated to 2 percent or less of assets. Thereafter a receivership is called for within 270 days to comply with capital standards though this time standard can and has often been extended.[4]

The more recent interest in subordinated debt prices extends beyond the early signaling of bank insolvency and has progressed to a proposal for the regulator to act on the signal of elevated subordinated debt yields and declare the bank critically undercapitalized (Shadow Financial Regulatory Committee (2000, p. 49)) and resolve the bank (Evanoff and Wall (2002)). Because the existing legal grounds for the regulator to fail a bank are insufficient capital, any early signal that results in the regulator seizing the bank's assets through a receivership must be tied to insufficient capital.[5] To not relate the receivership to insufficient capital exposes the regulator to a possible reversal of the receivership in the courts and the imposition of serious monetary penalties on the regulator (Schellhorn and Spellman (2000).[6] Hence if subordinated debt yields are to provide a signal that either invokes the PCA mandate for corrective action or results in a receivership of the bank's assets, it is important that the relationship of the subordinated debt yield to the bank's capital (solvency) be understood as the regulator will likely be challenged by the bank's claimants.

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[4] If the bank is declared to be critically undercapitalized the Act calls for a receivership or conservatorship not later than 90 days after an insured depository institution becomes critically undercapitalized. However, the Act explicitly allows receivership delays since the bank is given the opportunity to restore capital for a time period of up to 270 days and possibly longer (FDICIA, subtitle D, Section (3), subsection (h)(3)(c)(I)(ii)(I and II). After the expiration of the 270 days, additional delays are based on the Federal banking agency determination that the bank has positive net worth, the bank is in substantial compliance with an approved capital restoration plan, the bank is profitable or has an upward trend in earnings that agency projects as sustainable and the bank is reducing the ratio of non performing loans to total loans. See FDIC(l997, p.454) for data on actual delays.

[5] FDICIA requires that "critically undercapitalized" institutions be dealt with by appointing a receiver. (FDIC, Public Law 102-242, December 19, 1991, Subtitle D, Section 131, subsection (h)(3)). The method used to justify categorization of a bank as "critically undercapitalized" however, is left to the appropriate Federal banking agency (see FDICIA, Public Law 102-242, December 19, 1991, Subtitle D, Section 131, subsection (h)(3)(c)(i). Conceivably the banks subordinated debt yield spread to the Treasury can be invoked. However, it is likely that the receiver will be challenged to show that spreads are an appropriate criteria for determining a bank to be critically undercapitalized.

[6] The article cites instances when the courts reversed a receivership decision and awarded damages to the holders of the bank securities.

While the yield-insolvency linkage is important to the consideration of when and whether to fail a bank, much of the literature on subordinated debt yields relates to "default risk" (for example, Flannery and Sourescu (1996)). In the case of regulated banks, subordinated debt defaults if (a) the regulator believes the bank's capital has deteriorated to below 2 percent on a tangible assets basis, (b) the chartering authority elects to proceed to appoint the FDIC as a conservator or receiver of the bank's assets and debts or (c) the bank's liquidated assets indeed are insufficient to pay off both the bank's senior and subordinated debt.[7] Hence, the default risk that should be reflected in the market yield of subordinated debt is the prospect for inadequate capital (both on an a priori and ex post basis) and the timeliness of the receivership.[8] Delays in the receivership or forbearance lend value to the bank's securities as the banks are given the opportunity to recover and avoid the receivership. Hence, the yield premiums will reflect the bank's solvency state and investors' forbearance expectations.

The purpose of this paper is to relate bank subordinated debt yields and pricing to bank solvency and show how the yield-solvency relationship is affected by investors' expectations of forbearance. In the context of the options pricing model that will be employed, the expiration time of the contract encompasses the sum of the time for the regulator to recognize a bank as critically undercapitalized, the FDICIA allowed time to develop and execute a capital plan, and the time delays thereafter. We shall interpret the time of the expiration of the implied options contract as investor's "expected forbearance" encompassing all three delays that are normally found in any bank insolvency: the recognition time, the attempted remediation time and the receivership delays thereafter. That is the investors' expected forbearance is a variable that the regulator does not control, but investors will have an expectation of regulatory forbearance in terms of time delays that will affect the market value of

[7] It is possible for subordinated debt to go into default prior to a receivership, although we do not find any such cases. However, if the banking company were to violate a debt covenant, the investors could declare the debt in default and trigger a shortening of the regulator's forbearance.

[8] The default process for bank debt differs from the default process of the debt of non-financial private companies. For the non-financial private company, the inability of the company to provide debt service under the terms of the debt causes the trustee for the debt class to attempt to convince the bankruptcy court to liquidate the firm's assets and pay off the debt

their investment in the bank's debt or equity. We will demonstrate how expected forbearance affects the pricing performance of subordinated debt. Of special importance is its affect on the pricing signal as the bank nears the PCA trigger point of 2 percent of tangible capital and below.

In order for subordinated debt pricing to provide recognition of tangible insolvency, the implicit working assumption behind the mandatory subordinated debt proposal, is that the market yield spreads of subordinated debt to the riskless rate is reflective of the bank's declining solvency ratio. An unambiguous signal is important when the bank reaches 2 percent of tangible capital in order to present the regulator with the grounds to proceed with corrective action.[9] That is, deteriorating solvency should be reflected in rising yield spreads. These spreads should widen meaningfully prior to actual insolvency (zero capital ratio) in order to allow the regulator to confront the bank while it still has positive tangible capital.

This paper analytically examines the ability of subordinated debt yield spreads to recognize bank insolvency. We find that meaningful subordinated debt yield spreads occur when forbearance expectations are within the 270-day maximum allowed under PCA. However, as we show, longer forbearance expectations can cause the market yield spreads to fail to recognize the underlying solvency state of the bank until the bank is seriously insolvent. In fact under reasonable assumptions, the bank subordinated debt yield spreads are still generally less than a junk bond spread to the Treasury when the bank has seriously impaired capital at market value. This is because expected forbearance has sufficient value to makeup for the insolvency.

Given the possibility of long expected forbearance time, we then make an empirical investigation of the investors' implied forbearance expectations relative to the bank's solvency. These estimates are made monthly for selected bank holding companies for which traded subordinated debt

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holders. That is for the non-financial private company, cash flow, irrespective of solvency, triggers default, whereas the default of debt for the regulated bank follows insolvency if the regulator decides to proceed with a receivership.

[9] The OCC is bound to show insufficient capital where as state banking agencies might resort to showing "impaired" capital or unsound and unsafe practices.

and equity securities were outstanding during the l990s. These estimates of bank solvency and the corresponding forbearance expectations are made by the use of the contingent claims model for which forbearance expectations and solvency are derived from the market pricing of a bank's subordinated debt and equity. That is, the observed market data implicitly contain the investor's implied values of the bank's forbearance expectations and corresponding solvency ratio.

We find that there were episodes for individual bank's for which investors believed that the bank met the PCA 2 percent tangible capital criteria for intervention, but held expectations that PCA maximum of 270 days would not be observed. The debt was priced accordingly with market yield spreads that did not make it to the junk debt category. In general we find that yield spread-solvency relationships were weak because the investors were pricing long forbearance periods. *Indeed we found a perverse effect that forbearance expectations periods increased as banks lost solvency.*

In Section II, we review the literature on the information content of bank subordinated debt yield spreads and the literature on forbearance expectations. In Section III we specify the contingent claims model for the valuation of subordinated debt. We then provide analytical yield spread-solvency relationships. In particular we examine subordinated debt yields corresponding to the PCA 2 percent tangible capital threshold to determine what pricing signals can be anticipated for a given level of forbearance expectations. We go on to examine the effects of long versus short forbearance expectations on the subordinated debt-pricing signal of bank insolvency. In Section IV we make empirical estimates of the implied bank solvency and simultaneous forbearance expectations that are contained in the observed market prices of the bank's subordinated debt and equity. In general, we find that during the l990s forbearance expectations held by market investors in bank securities exceeded the 270-day criteria allowed in PCA and were usually in excess of 1 year and lengthened as the bank became more insolvent. In Section V we summarize and conclude regarding the ability to determine a bank's solvency relative to subordinated debt yield spreads and the apparent role of forbearance expectations to cause observed bank subordinated debt yields to fail to reflect bank

insolvency. Consequently, bank subordinated debt yield spreads require considerable interpretation in order to assess the bank's condition.

II. Subordinated Debt Yields Spreads, Solvency and Forbearance Expectations

In the empirical literature, subordinated debt yields have been studied for their information content as they relate to accounting measures (Flannery and Sorescu (1996) and Evanoff and Wall (2002)), to credit ratings (Berger, Davies and Flannery (2000)) and to bank examination ratings (DeYoung, Flannery, Land and Sorescu (2002) and Evanoff and Wall (2002)). Implicit in Flannery and Sorescu is a relationship of yields to bank capital where statistical significance in some years between 1983 and l991 was found for variables that relate to the bank's capital. These include variables associated with potential capital write-offs with a leverage variable that is largely driven by the market value of the bank's common equity, and the bank's size as measured by the book value of assets.[10] The results are not consistent year to year but improve after the passage of FDICIA with the PCA standards in l991. In fact previous studies of bank subordinated debt yields covering the pre-PCA era were notable in that they failed to find any relationship of subordinated debt yields to accounting risk measures (Avery, Belton and Goldberg (1998) and Gorton and Santomero (1990)). The authors attribute the Too-Big-To-Fail (TBTF) effect that shaped forbearance expectations prior to PCA in l99l that apparently reduced risk pricing of subordinated debt and have also been attributed to elevating equity pricing as well (O'Hara and Shaw (l990)).[11] In the context of this paper, TBTF implies forbearance expectations were lengthy. Additionally, forbearance expectations inherent in TBTF have been reported to be the motivation for bank mergers (Kane (2000)) that have been found to influence the pricing of bank debt (Penas and Unal (2001)).

[10] The variables that were statistically significant in the cross sections for some of the years are: the ratio of non-accruing loans to total assets, the ratio of non-accruing loans past due 90 days or more to total assets, the ratio of other real estate loans to total assets, the log of the issuing bank's total assets, and the ratio of total (book) liabilities to the market value of common stock plus the book value of preferred stock.

While the empirical studies of bank subordinated debt yield spreads provide some statistical support for both forbearance expectations and solvency issues, these studies only indirectly link the subordinated debt pricing to insolvency and the forbearance of the insolvent. To analyze the issue of the potential early warning of subordinated debt yields as they relate to deteriorating bank solvency, we employ the contingent claims framework of security prices that connects the pricing of the banks subordinated debt and equity to the investors' belief in the solvency of the bank. This relationship of debt and equity prices to solvency also depends on the investor's belief in the bank's asset variance and the time until expiration of the option. The time until expiration, in this context, can be thought of as determined by forbearance expectations.[12] When viewed in an options framework, the pricing of subordinated debt is dependent on the bank's market value of capital-to-assets ratio (solvency), the time until the option expires (expected forbearance) and the bank's asset return volatility. These are the relevant variables in the determination of subordinated debt prices.

Although regulators set actual forbearance, investors cannot escape making an estimate of this regulatory controlled variable as it impacts the value of their subordinated debt holdings.[13] Since forbearance time has value to investors, the investors' expected forbearance is priced. Investors might rationalize forbearance expectations based on their observation of historical forbearance performance. The FDIC estimates that the average time until closure of 343 banks between l984 and l992 from the time the bank was determined to have reached the 2 percent PCA tripwire was 1.21 years. When weighted by bank size, forbearance was 1.84 years after recognition of the PCA threshold.[14] These FDIC forbearance estimates were measured from when the FDIC first determined 2 percent solvency

[11] The Comptroller of the Currency testified before Congress in September, l984 that some banks were simply too big to fail henceforth known as TBTF.

[12] Forbearance expectations or the values of τ exist for all banks at all times irrespective of whether the bank is an immediate candidate for resolution. It is simply the implied life of the contract from that date forward. For solvent banks that have enjoyed extended lives, this occurs because each day in the market the investors "reinstate" the length of life of the options.

[13] Allen and Saunders (1993) characterize the process as a regulatory call on the owner's ability to put the bank assets back to the FDIC.

was reached which was generally based on notoriously trailing accounting data (Beaver, Datar and Wolfson (1992)). Recognition lags would also occur if the PCA trigger were supplied by bank examination data. This means of recognition also trails as examination intervals have averaged at least 1 year for all banks and 2.3 years for banks with low CAMEL ratings despite the relatively high incidence (36 percent) of failed banks that enjoyed low CAMEL ratings within one or two years of failure.[15]

Hence, with substantial recognition lags of tangible capital based on accounting or examination data, it is reasonable to believe that investors' forbearance expectations could well be longer than the maximum of 270 days mandated by PCA. Another reason for investor forbearance expectations to be lengthy is that 73 percent of banks that reached the PCA insolvency threshold were given the time to become solvent and were not subsequently resolved.[16] Thus, investors have observed that forbearance adds value to bank securities as it often enables the bank to regain solvency and retain its "going concern" value.

Bank subordinated debt pricing also is responsive to investors' implicit estimate of asset volatility. This is a measure of the risk of asset value that incorporates any balance sheet or current income impact on the market value of the bank's assets. In effect, the asset volatility is measured as the annualized standard deviation of the bank's return on assets and incorporates the risk influences found in many studies having to do with asset reserving, write-offs or variation in income.

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[14] The data are found in FDIC (1997, Table 12.15, p. 455). The data is given in terms of days. The authors converted these to years of forbearance.

[15] Table 12.1 FDIC (1997) p. 429 details the average examination interval by year between l979 and 1994 by CAMEL rating. The longest intervals were 845 days or 5 years for CAMEL 1 banks in l986. The shortest was 245 days or .67 years for the CAMEL 5 banks in 1994.

[16] FDIC, ibid, p. 439.

III. The Yield Spread-Solvency Model

A. The Contingent Claims Model for Bank Subordinated Debt and Equity

In order for subordinated debt yields to be a signal of bank insolvency, the market yields should monotonically increase as insolvency is approached. This would appear to be the presumed yield-solvency relationship behind the mandate for subordinated debt. To relate the investors' subordinated debt yield relative to solvency we rely on Black and Cox (1976), Smith (1979) and Cox and Rubinstein (1985) who show that the market value of subordinated debt, D_{Sub}, equals the value of the difference between two European call options on the value of assets with strike prices of senior debt and total debt and is given by:[17]

$$D_{Sub} = c(V, B_{Dep}) - c(V, B_{Dep} + B_{Sub}). \quad (1)$$

where D_{Sub} is the market value of subordinated debt, V is the unobserved market value of assets, B_{Dep} is the present value of the promised value of senior debt (deposits for most banks) discounted at the risk-free rate to period T and B_{Sub} is the promised value of subordinated debt discounted at the risk free rate.

Applying continuous time approximations to these relationships and the assumptions of the Black-Scholes-Merton options-pricing model gives the market value of the subordinated debt as:

$$D_{Sub} = V\,N(d_1) - B_{Dep}\exp(-R_f\boldsymbol{t})N(d_2) - VN(g_1) + (B_{Sub} + B_{Dep})\exp(-R_f\boldsymbol{t})N(g_2) \quad (2)$$

This can be simplified to the relationship as presented in Gorton and Santomero (1990):

$$D_{Sub,} = V\,[N(d_1) - N(g_1)] - B_{Dep}\exp(-R_f\boldsymbol{t})N(d_2) + (B_{Sub} + B_{Dep})\exp(-R_f\boldsymbol{t})N(g_2)$$

where,

$$d_1 = \left[\ln\left(V/B_{Dep}\right) + \left(R_f + 0.5\boldsymbol{s}_V^2\right)\boldsymbol{t}\right] \Big/ \boldsymbol{s}_V\sqrt{\boldsymbol{t}} \quad \text{and} \quad d_2 = d_1 - \boldsymbol{s}_V\sqrt{\boldsymbol{t}}\,,$$

$$g_1 = \left[\ln\left(V \Big/ \left(B_{Dep} + B_{Sub}\right)\right) + \left(R_f + 0.5\sigma_V^2\right)\tau \right] \Big/ \sigma_V\sqrt{\tau} \quad \text{and} \quad g_2 = g_1 - \sigma_V\sqrt{\tau}$$

V = the market value of assets,

B = the promised value of bank liabilities discounted at the risk-free rate to time T,

R_f = the risk-free rate with a maturity consistent with the time to asset valuation (bank examination),

τ = the market-perceived time until receivership,

σ_V = the standard deviation (volatility) of the rate of return on assets,

ln(x) = the natural logarithm of x,

exp(x) = the value e raised to the power of x, and

N(x) = the cumulative standard normal distribution.

Consistent with the above model of subordinated debt, the equity value of a firm can be considered as a call option on its assets with a strike price being its total promised debt, B, is:

$$E = VN(g_1) - (B)\exp(-R_f\tau)N(g_2) \qquad (3)$$

where E is the market value of equity and g_1, g_2 and all other variables are defined as above.

Our objective is to estimate three parameters of the contingent claims model of pricing: the market value of assets, V, the volatility of asset returns, σ_V, and the investors' expected time to resolution, τ. To solve for three variables a third equation is necessary. Ronn and Verma (1996) and Hull (2000, p.630-631) show that by applying Ito's lemma to the generating process for the value of assets, the following relationship with observable market value of equity and its volatility can be used as the third equation in our system:

$$\sigma_E E = N(g_1)\sigma_V V \qquad (4)$$

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[17] The valuation equation for subordinated debt is derived in Black and Cox (1976) and Smith (1979). Cox and Rubinstein (1985) show that the subordinated debt value equals the difference between two European call options:

where σ_E is the volatility of equity of the bank and all other variables are as defined above. Equation (4) shows that the volatility of assets, σ_V, can be considered a leverage adjusted value of the volatility of equity:

$$\sigma_V = \sigma_E(E/(VN(g_1)) \quad (5)$$

The market value of assets can be approximated by the market value of equity and the market value of debt. The value of $N(g_1)$ is the likelihood of the normalized value of asset return being less than g_1 or the value of the recovery of assets upon default (see Hull, 2000, p. 631).

The relationship in equation (1) can be stated in terms of an interest rate risk premium, or spread, defined as the difference between the yield to maturity on the risky debt, R_{Sub}, and a default risk-free security such as a U.S. Treasury security of the same remaining maturity, R_f. This is done by recognizing that the market value of the subordinated debt is the continuous discounted value of the promised amount at the market rate of interest on the debt and treating it as a zero coupon debt instrument (all values are evaluated at time t before expiration):

$$D_{Sub} = B_{Sub} \exp(-R_{Sub}\tau) \quad (6)$$

Substituting from equation (2) above, the default risk premium, $R_{Sub} - R_f$, is:

$$R_{Sub} - R_f = -\ln\{V/B_{Sub} \exp(R_f \tau)[N(d_1) - N(g_1)] - (B_{Dep}/B_{Sub})N(d_2) + (B_{Sub} + B_{Dep})/B_{Sub}\, N(g_2)\}/\tau \quad (7)$$

Equation (7) is used to simulate the theoretical risk premium, assuming values for all the parameters. In addition, equation (7) is used as one of the three equations to estimate the unobserved parameters of interest: V, σ_V, and τ.[18]

B. Subordinated Debt Yield Spread-Solvency Relationships

To demonstrate the contingent claim relationship of yield spreads to bank solvency, measured as the ratio of the difference between the value of assets, V, and debt, B, to the value of assets, we

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$D_j = c(V, B_S) - c(V, B)$.

generate the yield spread-solvency loci of points plotted in Figures 1 and 2. This relationship is obtained from equation (7) by varying the market value of assets, V, relative to total promised debt, B, (thus varying solvency) for an assumed R_f value of 2.8 percent for 90-day Treasury securities and 3.2 percent for 1-year or 2-year Treasury debt and an assumed σ_V of 5 percent (Figure 1) and 10 percent (Figure 2).[19] B_{Sub} is assumed to be 1.0 percent of B_{Dep} so that, like most banking companies issuing subordinated debt, it is a minor portion of the bank's capital structure. The promised yield spread-solvency curves are displayed for different forbearance expectations periods: the PCA minimum 90 days and maximum of 270 days, and 1-year, 2-years and 3-years. In Figure 1 the yield spreads are computed using a σ_V of 5 percent and in Figure 2 the forbearance periods are the same, but computed using a σ_V of 10 percent. Each curve is a locus of points of subordinated debt yield spreads and bank solvency for different forbearance expectations periods.

The yield spreads corresponding to the different levels of forbearance expectations are shown in both Figures 1 and 2, exhibit a similar pattern of rising yield spreads as solvency declines. The yield spread reaction is more sensitive for shorter forbearance expectations periods. That is, if investors believe in the short PCA mandated 90 day resolution time the yield spread signal starts to react at higher threshold solvency levels and with wider yield spreads. This is the basis for the PCA legislation.

To interpret the subordinated debt yield signal at the PCA threshold of 2 percent capital adequacy, we examine the yield spreads across forbearance expectation pricing loci for that solvency ratio. At the 2 percent solvency ratio the yield spreads for the short 90 day resolution time results in declining subordinated debt prices with yield spreads rising to over 5,000 basis points. However for the more lengthy resolution periods, the yield spreads have risen much less and are in the 560 basis

[18] Subordinated debt spreads are used in the study instead of debt prices because they have been more prominent in previous studies. Debt prices could also be used in the estimation with equal efficiency.

[19] This range for σ_V encompasses a similar range found by Hanweck (2001) for the largest 25 banking companies with outstanding subordinated debt in the first half of 1999.

point and within the junk bond range.[20] For forbearance expectations of 3 years, the yield spreads are well below junk bond ranges and suggest that if investors believe forbearance periods of this length to persist there will be little in the way of a signal of bank insolvency condition from yield spreads until the bank has reached extreme insolvency.

It should be noted that if investors believe that a bank is at the threshold of insolvency, they are willing to pay positive prices for the subordinated debt as a result of the value imparted by the delayed resolution. In fact the yield spreads at zero capital for the historically observed 1 year to 2 year range of resolution time results in yields spreads that are well within the junk debt tolerance. Thus if investors believe that past resolution delays are to be expected in the future, the subordinated debt yield spread signal is not alarming high.

Moreover if investors believe that additional time will be given to those banks that fall deeply into insolvency, that is a systematic increasing of forbearance expectation time with declining solvency, this can be interpreted in the Figures as a switching from one pricing loci to another as solvency declines. If the switching is to longer forbearance expectations as solvency declines, the subordinated debt pricing signal is highly muted.

What this simulation exhibits is that forbearance, if priced by investors, blunts the pricing of the actual and near insolvent banks' securities and works at cross purposes with providing early recognition of deteriorating financial condition. Even if investors believe that the PCA maximum forbearance will be observed, it does not cause a dramatic yield spread to be priced. For banking companies considered immune from regulatory closure, PCA time period expectations are very long resulting in a subordinated debt signal that is "too weak" and, perhaps, "too late" to provide market discipline either for the bank or the regulator.

[20] These yield loci hold constant all other factors. However as the bank moves toward or deeper into insolvency, investors might believe that the riskiness of assets increase (moral hazard) or decrease (effective market discipline) or that τ declines

IV. Empirical Estimate of Forbearance Expectations and Bank Solvency

A. Data For Empirical Estimates

In this section we present empirical estimates of the market value of assets, V, the volatility of asset returns, σ_V, and the measure of the forbearance expectations period, τ. These empirical estimates are the values implied in the investors' pricing of banking company subordinated debt and equity. That is, we measure the investors' view of the bank's market value of assets and the investors' simultaneous view of the forbearance that will occur. Using equations (3), (5) and (7), presented above, we solve for each of these variables using market data for eleven banking companies for which both market traded subordinated debt and equity were available during the l990s. These include some that were considered by investors to be insolvent or nearly insolvent, whether or not they subsequently failed or were acquired. The observed information used to structure these solutions is each company's market value of equity, E, the volatility of equity, σ_E, the spread on its subordinated debt over a comparable maturity Treasury security, $R_{Sub} - R_f$, the value of promised or face value of subordinated debt, B_{Sub}, and the value of deposits, B_{Dep}.[21] From these estimates, we solve for the bank's implied asset value, V, from which we then back out the solvency ratio, $((V - B)/V)$, given the observed level of the book value of debt, B. We are then able to examine the relationship of subordinated debt yield spreads with solvency and the impact of forbearance expectations on those relationships.

The data sources for this study are Interactive Data Corporation for subordinated debt prices, yields and equity values, the Federal Reserve Y-9C quarterly bank holding company reports of income and expenses and balance sheet data subordinated and other debt obligations, and the Federal Reserve Board H.15 release for constant maturity Treasury security yields to maturity for the risk-free rate. The value of equity is the total market value capitalization of the banking company for each date;

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if regulators respond in a shorter time frame per the PCA legislated mandate of early closure and least cost.

correspondingly, the volatility of equity return is based on the changes in total capitalization plus dividends at annual rates. Solutions are computed monthly based on end-of-month weekly data so that the volatility of equity returns is the end-of-month weekly value of the annualized volatility based on a 10-week rolling standard deviation of weekly returns. The corresponding equity market value is based on the closing stock price for the end of the week at the end of each month. This timing keeps values for the data consistent with the total assets, deposits and outstanding subordinated debt from the quarterly balance sheet reports from the Federal Reserve Board's Y-9C bank holding company report.

The period we chose to study is from November 1996 to March 1999. During this period, banks went from little stress to highly stressed after the August 1998 Russian default and the subsequent collapse of Long Term Capital Management (LTCM) in October 1998. The yield spreads for the subordinated debt issues of the 25 largest banking companies show this pattern of stress over this period (Figure 3). This pattern is also exhibited for individual banking companies in our sample. Table 1 shows a break down of the debt characteristics by banking company for the periods to May 1998 and after May 1998. Without exception, the banking companies in our sample experienced rising subordinated debt spreads that, as of this writing, have yet to return to the pre-May 1998 level. It is important to realize, however, that the yield spreads for the banks in our sample are much smaller than what can occur when a banking company is in serious financial condition. For example, the Bank of New England was a case of such a bank when, from 1989 until its closing in 1991, it experienced subordinated debt yields of up to 4000 basis points.

The selection of our period for analysis has the added benefit of minimizing the need for extensive merger adjustment of the data for banking companies chosen for this analysis. As can be seen from Table 1, the banking companies in the sample are among the largest companies in the U.S.

[21] In these models, we assume that all non-deposit debt and senior secured debt of the banking company is of similar recovery priority status if the banking company defaults.

In addition, with the exception of JP Morgan, Chase Manhattan and Bankers Trust, these companies have survived independently until Fall-2002.

The number and size of the subordinated debt issues varied considerably among companies. For the sample of 11 BHCs, the study includes 363 issues with a total outstanding amount, by original issue, of $49.3 billion (Table 1). Based on September 30, 1998 FR-Y9C reports, the 11 companies accounted for about 80 percent of reported subordinated debt on balance sheets of consolidated BHCs in the U.S. in 1998 compared to the largest 34 companies that account for practically all traded subordinated debt issued by banks and bank holding companies.

B. Descriptive Statistics

In Table 2 are presented descriptive statistics of the observed variables and the estimated variables. The latter are obtained by solving the contingent claims model for these variables in terms of the observed market data and debt promised values. It is interesting to note that the mean and median of the book and market values of assets are similar and that the equity volatility is about five times the implied asset volatility estimated from the model. The implied solvency ratio averaged 11 percent for the banks in the sample over the period, but was associated with a large standard deviation. For example, a negative one standard deviation from the mean would reduce solvency to 4.6 percent, a value approaching the 2 percent critical solvency value. Similarly, the average of forbearance expectations is slightly more than a year, in line with the current bank examination cycle. Forbearance expectations could lengthen, as a one-standard deviation increase from the mean would result in an eight-month increase to nearly two years. These results suggest that the estimates of implied volatility, solvency and forbearance are highly variable among banks and over time such that simple cross-section averages for short periods of time (e.g., six months) may be insufficient to isolate a change in a bank's solvency or risk profile.

C. Yield Spreads and Forbearance Expectations

The average of yield spreads for all observations is 78 basis points and rarely does an individual bank's yield spread climb into the junk bond range. The relationship of yield spreads to solvency is shown in Table 3. These statistics indicate that the subordinated debt yield spreads are generally not responsive to declining bank solvency. Yield spreads of banks that investors believed to have less than a 2 percent solvency ratio averaged 85 basis points or 8.4 basis points higher than for the banks with greater solvency (Table 3, column 3). However, these differences in yield spreads for those under and over 2 percent solvency are not statistically different. These results indicate that yield spreads provide, on the face of it, little signaling effect of market value insolvency. The failure to observe a relationship between yield spread and solvency is also apparent in Figure 4 that plots the respective values for Bankers Trust and Chase Manhattan.

The lack of a clear subordinated debt yield signal is consistent with investors believing longer forbearance will be the de facto response when large banks approach insolvency as analyzed in Section III.[22] Evidence of the possible role of forbearance expectations in influencing the subordinated debt signal is contained in Table 3. We find that our estimates of forbearance expectations are longer when the solvency ratio is 2 percent or less (1.34 years or 16 months) and statistically significant from the overall mean and for those banks with solvency ratios greater than 2 percent (Table 3). The statistical test is provided by computing a z value of 2.23 that is statistically significant at less than the 1 percent level for a one-tailed test. This result is consistent with investors having longer forbearance expectations as banks approach insolvency.

Further evidence of the apparent relationship between forbearance expectations and solvency are provided from estimates for Bankers Trust and Chase Manhattan, the banks that exhibited the most

[22] Under Prompt Corrective Action in FDICIA, a bank is considered to be "critically undercapitalized" when the ratio of tangible capital to total assets is 2.0 percent or less (12CFR, Ch. III, Subpart B, section 325.103(c), FDIC 1992). The capital and asset values referred to in the law are in terms of book values, with no reference to market values. Thus, the 2.0 percent solvency ratio in market value terms is likely to correspond to book capital ratios in excess of 2.0 percent.

numerous low solvency ratios in the time period studied. These relationships are shown as a scatter plot in Figure 5 and unambiguously indicate that as solvency declines forbearance expectations lengthen. For both of these companies, there was a jump in forbearance expectations as solvency declined below 2 percent. We find that, for these banking companies, estimated forbearance expectations were generally above 270 days or 0.75 years after their solvency was less than 2 percent. That is, forbearance expectations levels were well in excess of the PCA maximum. Furthermore, forbearance expectations were long enough to add sufficient value to blunt the effect of insolvency on the pricing of bank subordinated debt and indeed lengthened with the bank's insolvency. The extension of forbearance expectations with reduced solvency indicates that investors held out little hope for early regulatory intervention when banks were near insolvency and hence did not price this regulatory risk of early resolution.

D. Multivariate Tests of Forbearance Expectations and Bank Solvency

To clarify the relationship of forbearance expectations and solvency, we regress forbearance expectations on solvency for our sample of banking companies in a pooled time series-cross section relationship.[23] To do so we need to control for asset volatility. Furthermore, in order to account for the non-linearity inherent in the model, the functional form for forbearance expectations is a quadratic in solvency and asset volatility with an interaction term between these two variables. This is equivalent to a second order expansion of the functional relationship among these variables. In Table 4 are presented the results of a simple linear regression (Panel 1) for comparison and the quadratic form (Panel 2). The adjusted R^2 for the quadratic form improves to 0.47 from 0.26 for the linear model

[23] In these regressions each of the variables is computed from the model and is contemporaneous. Since they are computed and not observed, there should be no concern with simultaneity bias. If regressions were run with observed variables, such as the subordinated debt spread, on the computed variables, there would be a simultaneous bias and questions of consistency would arise.

indicating that the nonlinear relationship is a superior form. The levels of statistical significance for the variables are very high at probably levels of 0.0001 of being different from zero.

Using the quadratic form, the derivative values of forbearance expectations with respect to solvency are evaluated at the means of the variables and for solvency ratios of 2 percent, 0 percent and –1 percent with asset volatility set to its mean value and the mean plus one standard deviation. The derivative values for each assumption are shown in Panel 3 of Table 4. The derivative values for forbearance expectations with respect to solvency are all negative for different levels of solvency and mean values of asset volatility. The magnitudes of the derivatives are between -0.63 and -0.71 at the mean of σ_V and imply that each percentage decline in solvency from the initial assumed value results in the lengthening of forbearance expectations by approximately seven to eight months.[24] The solvency derivatives for greater assumed values of σ_V are considerably larger (by about 2/3), indicating that a one percent decrease in solvency will lead to an increase of up to twelve months in forbearance expectations. These regression results suggest a very meaningful economic and numerically significant relationship among forbearance expectations, solvency and asset volatility.

V. Summary and Conclusions

It has been proposed that bank subordinated debt yields be used as a signaling device to reflect a bank's deteriorating financial condition. Of particular interest to those charged with the bank safety net is a reduction in the recognition lag of bank distress in order to promote self-correction by the bank or for the regulator to prevent costly forbearance of an insolvent bank. Using the contingent claims model, we relate the signaling device, the bank's subordinated debt yield spread, to the investors' view of the bank's solvency and forbearance expectations. Analytically we find that, if investors have relatively short forbearance expectations, the bank's poor solvency state will be unambiguously

signaled by the yield spreads on subordinated debt, but forbearance expectations in excess of one year will offset the pricing of the underlying solvency problem. Empirically we find that, for monthly observations for eleven banking companies in the l990s, subordinated debt yield spreads failed to reflect deteriorating solvency positions which we then find to be due to long and lengthening forbearance expectations as the bank's solvency declined.

The working presumption of the subordinated debt requirement and proposed actions based on subordinated debt yields is that pricing is a reflection of individual bank risk. We find that at the critical point when solvency is threatened, regulatory behavior measured in years of forbearance expectations may dominate debt pricing, rather than the condition of the bank.

In conclusion, our data reveal that during the l990s forbearance expectations held by investors greatly exceeded the legislated maximum forbearance of 270 days even as the banks' solvency seriously declined. This gap between the market perceptions of forbearance and the legislated forbearance tolerance shows that expectations cannot be legislated. Furthermore, with forbearance expectations influencing the pricing of subordinated debt, these market values and spreads would not be useful indicators for pricing bank risk. Rather, regulatory agencies, charged with recognition and action in response to bank insolvency, must be mindful of the need to manage investors' forbearance expectations as well as actual forbearance since there is little doubt that forbearance expectations are linked to the precedents set by actual forbearance. Consequently, enforcing a strict forbearance standard, such as the PCA standard, would influence the price response of subordinated debt and perhaps make it a more consistent reflection of the bank's condition.

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[24] The level of asset volatility also affects the size of the forbearance expectation derivative. Larger asset volatility measured at the mean plus one standard deviation gives rise to larger forbearance expectations responses to changes in solvency.

Table 1: **Summary Statistics by Company**

Company Name	**No. of Sub. Debt Issues**	**Face Amt 12/18/98 ($000)**	**Average Yield Spread**		**Average Stock Volatility**		**Moody's Debt Rating***
			Nov 1996 to May 1998	May 1998 to March 1999	Nov 1996 to May 1998	May 1998 to March 1999	
Chase Manhattan	58	6,604,475	0.6367	1.0364	30.5346	42.9658	(50) A1; (5) Aa3
Citicorp	96	4,897,200	0.8040	1.2587	34.4208	49.5568	A1
Bank America	80	14,394,134	0.6324	0.9772	25.8979	37.7665	(2) A1; (4) Aa2; (76) Aa3
JP Morgan & Co.	13	2,655,000	0.5510	1.0194	24.1677	37.5140	(1) A1; (12) A2
First Union	31	5,525,000	0.5864	0.8923	22.1521	36.7355	(2) A1; (29) A2
Bankers Trust	15	2,050,000	0.6933	1.3485	23.8217	46.9745	A3
BankOne	30	5,630,000	0.6221	0.9159	30.6778	37.4383	(22) A1; (8) Aa3
Wells Fargo	16	2,950,000	0.6333	0.9606	25.3878	34.6540	A1
Fleet Financial	8	1,382,000	0.5985	0.8425	21.4809	36.3518	A3
PNC	7	1,550,000	0.6210	0.9143	24.7029	32.4525	A3
KeyCorp	9	1,675,000	0.6104	0.9573	22.3181	35.2185	(5) A1; (4) A2
Totals and Averages	**363**	**49,312,809**	**0.6354**	**1.0112**	**25.9602**	**38.8753**	

* Rated bonds may not equal the number outstanding owing to unrated subordinated debt in some bank portfolios.

Sources: Interactive Data Corporation and Bloomberg for debt and equity values and debt ratings. Yield spreads are computed using the difference between the yield to maturity for a bond and the yield on a Treasury note or bond of similar maturity. Treasury yield data are from the Federal Reserve Board, H.15 release.

Table 2: **Descriptive Statistics for Estimated and Observed Variables**

Variable	Mean	Standard Deviation	Median
Forbearance Expectations (τ) (years)	1.0230	0.6675	1
Estimated V ($M)	220025.3	122607.6	191460.3
Asset Volatility (σ_V)	0.0684	0.0352	0.0667
Book Value V ($M)	210836.7	119946.6	179052.5
MV Equity ($M)	32300.8	22848.21	25362.86
Solvency ((V-B)/V)	0.1096	0.0629	0.1251
Equity Volatility (σ_E)	0.3506	0.2427	0.2911
Yield Spread over Treasury	0.0078	0.0028	0.0068
R_f risk-free rate(%)	5.3083	0.4455	5.42

Number of observations: 294

Sources: Market value data for debt and equity are from Interactive Data Corporation collected on a weekly basis. Book values are from the Federal Reserve Y-9C report. All returns and volatilities are at annual rates. Equity volatility, σ_E, is computed as the standard deviation of annualized weekly returns using 10 prior weeks. Forbearance expectations, τ, estimated asset value, V, and asset volatility, σ_V, are estimated from the model using equations (3) (5) and (7) in the text.

Table 3: **Statistics by Solvency Ratio**

By Solvency Ratio	Solvency Ratio (V-B)/V	Spread over Treasury	Forbearance Expectations (τ, years)	SigmaV (σ_V)	Total Number of Observations
0.02 or less	-0.01512	0.00854*	1.34259**	0.01703	28
Greater than 0.02	0.12179	0.00770	0.99067	0.07343	266
Overall	0.10957	0.00778	1.02296	0.06842	294

** Statistically significant at 1 percent or less from the sample mean (z = 2.23, on a one-tail test).
* Not statistically significant from spreads for banks with better solvency.

Table 4**: Cross Section-Time Series Regressions of Estimated Forbearance Expectations, τ, on Solvency and σ_V**

Panel 1

Linear Functional Form

	Coefficients	Standard Error	t-statistic		
Intercept	1.52**	0.07	20.77	Adjusted R^2	0.26
Solvency Ratio ((V-B)/V)	7.53**	1.13	6.65	Std. Error	0.57
SigmaV (σ_V)	-19.35**	2.02	-9.56	F-Value	52.89**

** Statistically significant at a 1 percent level or less.

Panel 2

Quadratic Functional Form

	Coefficients	Standard Error	t-statistic		
Intercept	1.30**	0.15	8.82	Adjusted R^2	0.47
Solvency Ratio ((V-B)/V)	20.19**	2.47	8.19	Std. Error	0.48
SigmaV (σ_V)	-32.58**	5.81	-5.61	F-Value	53.61**
Solvency^2	340.03**	34.10	9.97		
SigmaV^2	999.03**	99.25	10.07		
Solvency*SigmaV	-1227.47**	125.84	-9.75		

** Statistically significant at a 1 percent level or less.

Panel 3

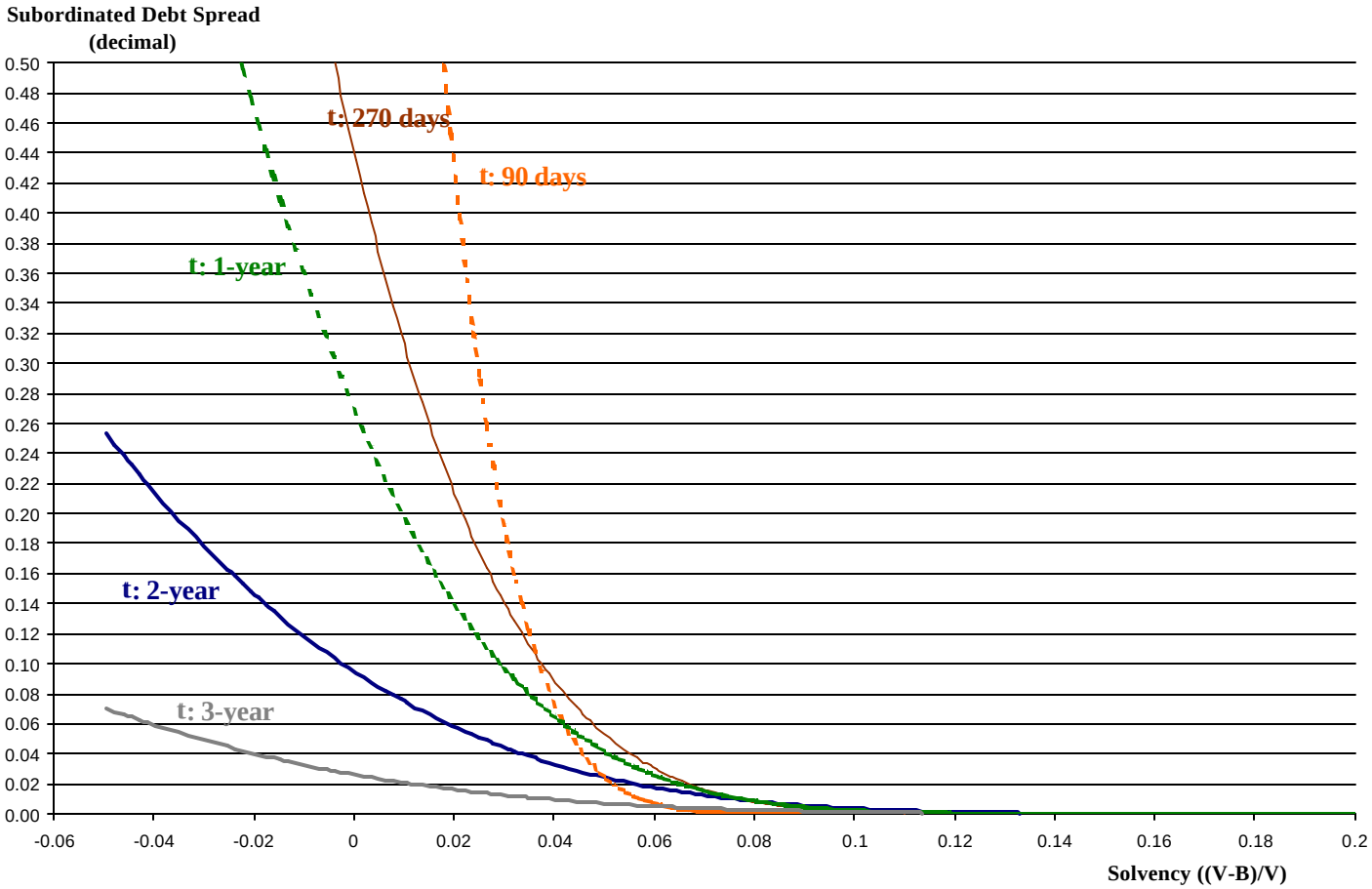
First Derivatives from the Quadratic Functional Form[1]	At Mean of σ_V = 0.0684	Mean plus one standard deviation σ_V = 0.104
d τ /dSolvency (at means)	-70.91	-109.69
d τ /dSolvency (Solvency = .02)	-65.07	-103.86
d τ /dSolvency (Solvency = 0)	-63.76	-102.55
d τ /dSolvency (Solvency=-0.01)	-63.11	-101.90
d τ /dσ_V (at means)	-30.44	32.70
d τ /dσ_V (Solvency = .02)	79.53	142.68
d τ /dσ_V (Solvency = 0)	104.08	167.23
d τ /dσ_V (Solvency = -0.01)	116.36	179.50

[1] Statistical significance of these derivatives has not been computed. However, since each of the component coefficients is highly significant, these derivatives are expected to be so as well.

Figure 1

Subordinated Debt Spread-Solvency Relationship for Selected Forbearance Expectations, t (s_V = 0.05)

(by asset volatility (σ_V) and τ; a decimal spread of 0.5 is 5,000 basis points)

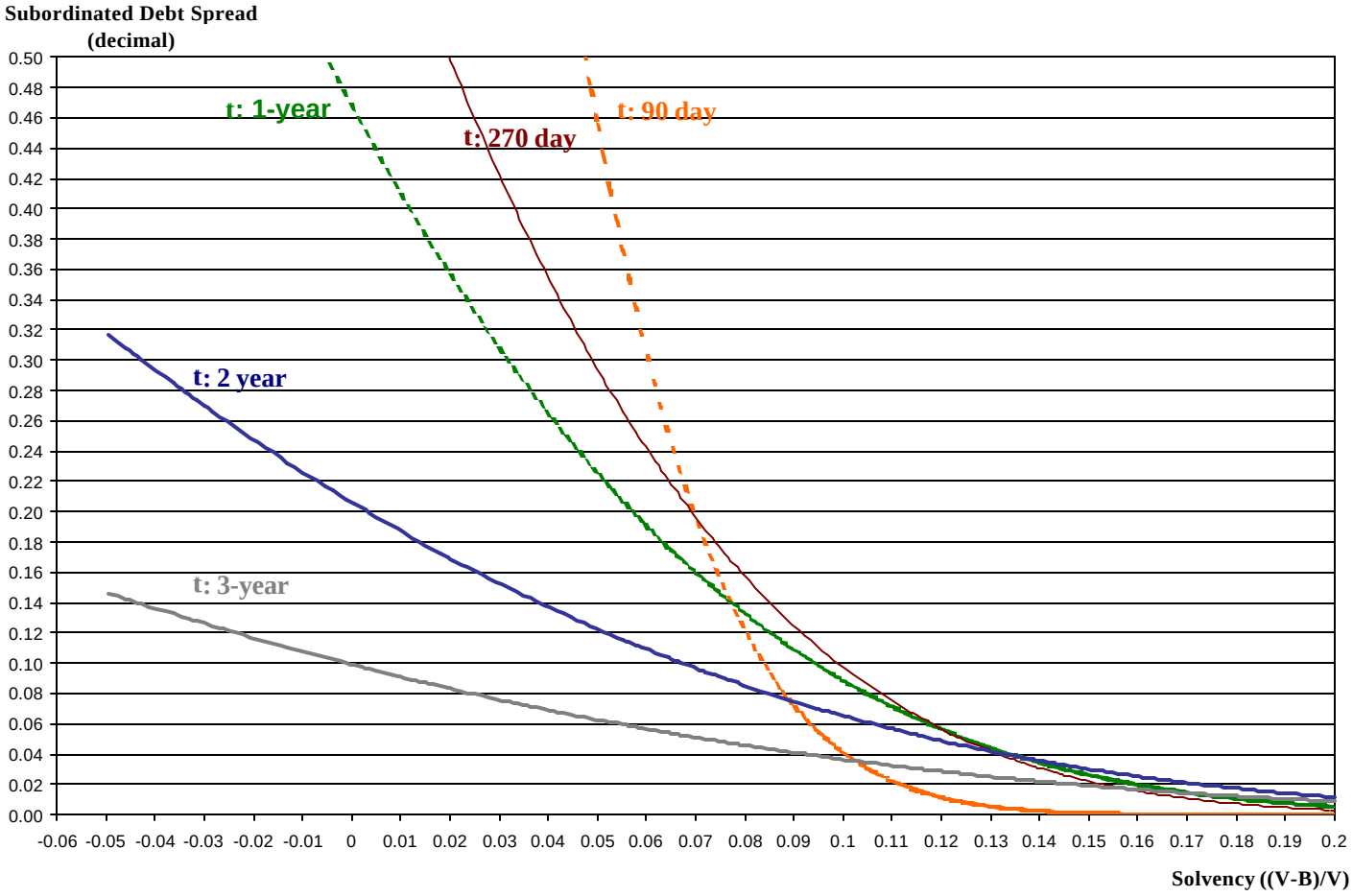


These relationships are obtained from equation (7) in the text by varying the market value of assets, V, relative to total promised debt, B, thus varying solvency. Each loci is computed for an assumed R_f value of 2.8 percent for 90-day Treasury securities and 3.2 percent for 1-year, 2-year and 3-year Treasury debt and an assumed σ_V of 5 percent (Figure 1) and 10 percent (Figure 2). These asset volatilities are within the range found in this study and are near the values in Hanweck (2001). B_{Sub} is assumed to be 1.0 percent of B_{Dep} so that, like most banking companies issuing subordinated debt, it is a minor portion of the bank's capital structure. The promised yield spread-solvency loci are displayed for different forbearance expectations periods: the PCA minimum 90 days and maximum of 270 days, and 1-year, 2-years and 3-years. In Figure 1 the yield spreads are computed using a σ_V of 5 percent and in Figure 2 the forbearance periods are the same, but computed using a σ_V of 10 percent. Each curve is a locus of points of subordinated debt yield spreads and bank solvency for different forbearance expectations periods.

Figure 2

Subordinated Debt Spread-Solvency Relationship for Selected Forbearance Expectations, t (s_V = 0.1)

(by asset volatility (σ_V) and τ; a decimal spread of 0.5 is 5,000 basis points)



In Figure 2 the yield spreads are computed using a σ_V of 10 percent and all other factors, including the forbearance expectations periods, are the same as for Figure 1. Each curve is a locus of points of subordinated debt yield spreads and bank solvency for different forbearance expectations periods and has the same interpretation as in Figure 1.

Figure 3

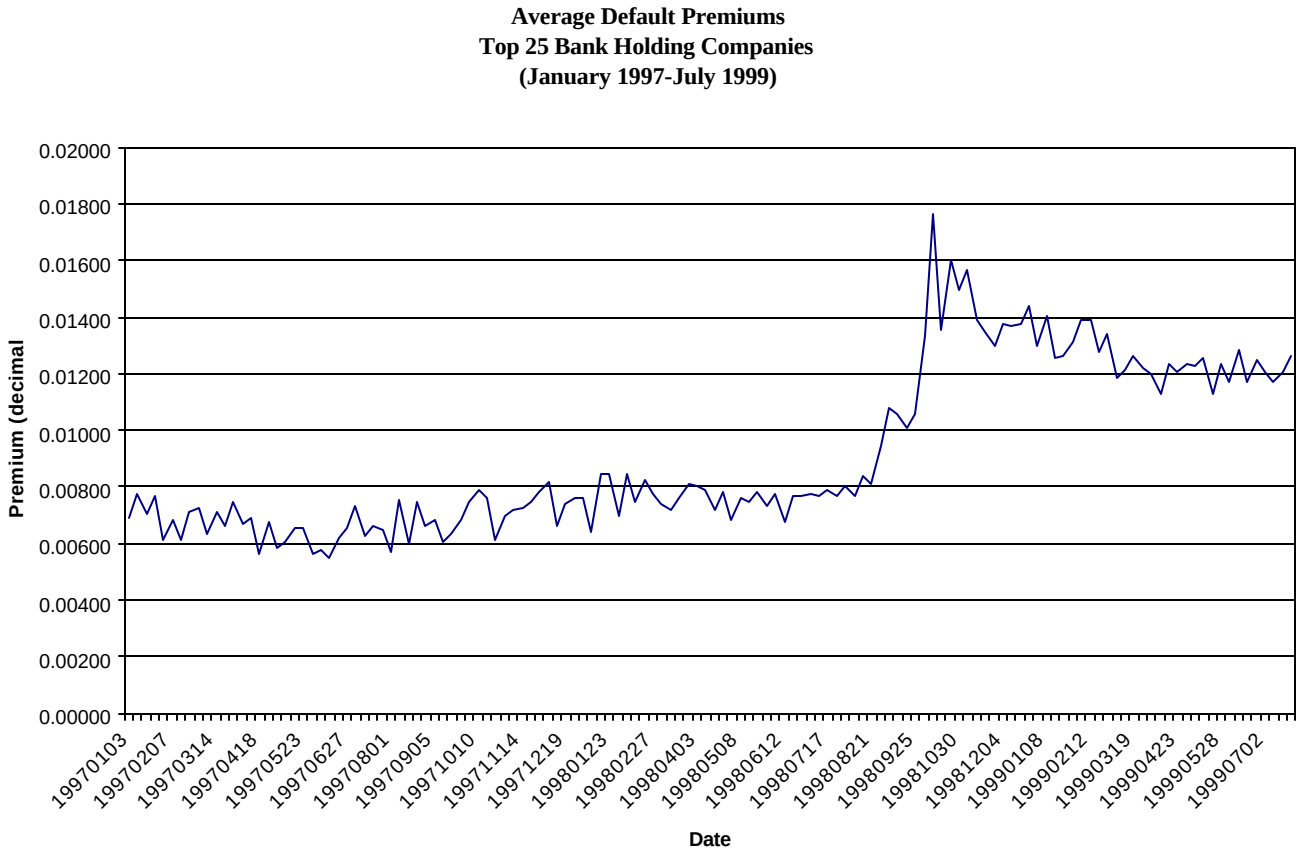

Average Default Premiums
Top 25 Bank Holding Companies
(January 1997-July 1999)
Premium (decimal
0.02000
0.01800
0.01600
0.01400
0.01200
0.01000
0.00800
0.00600
0.00400
0.00200
0.00000
19970103
19970207
19970314
19970418
19970523
19970627
19970801
19970905
19971010
19971114
19971219
19980123
19980227
19980403
19980508
19980612
19980717
19980821
19980925
19981030
19981204
19990108
19990212
19990319
19990423
19990528
19990702
Date

Figure 4

Scatter Plot of Spread and Solvency:
Selected Bank Holding Companies (Bankers Trust and Chase Manhattan)
(November 1996 to March 1999)

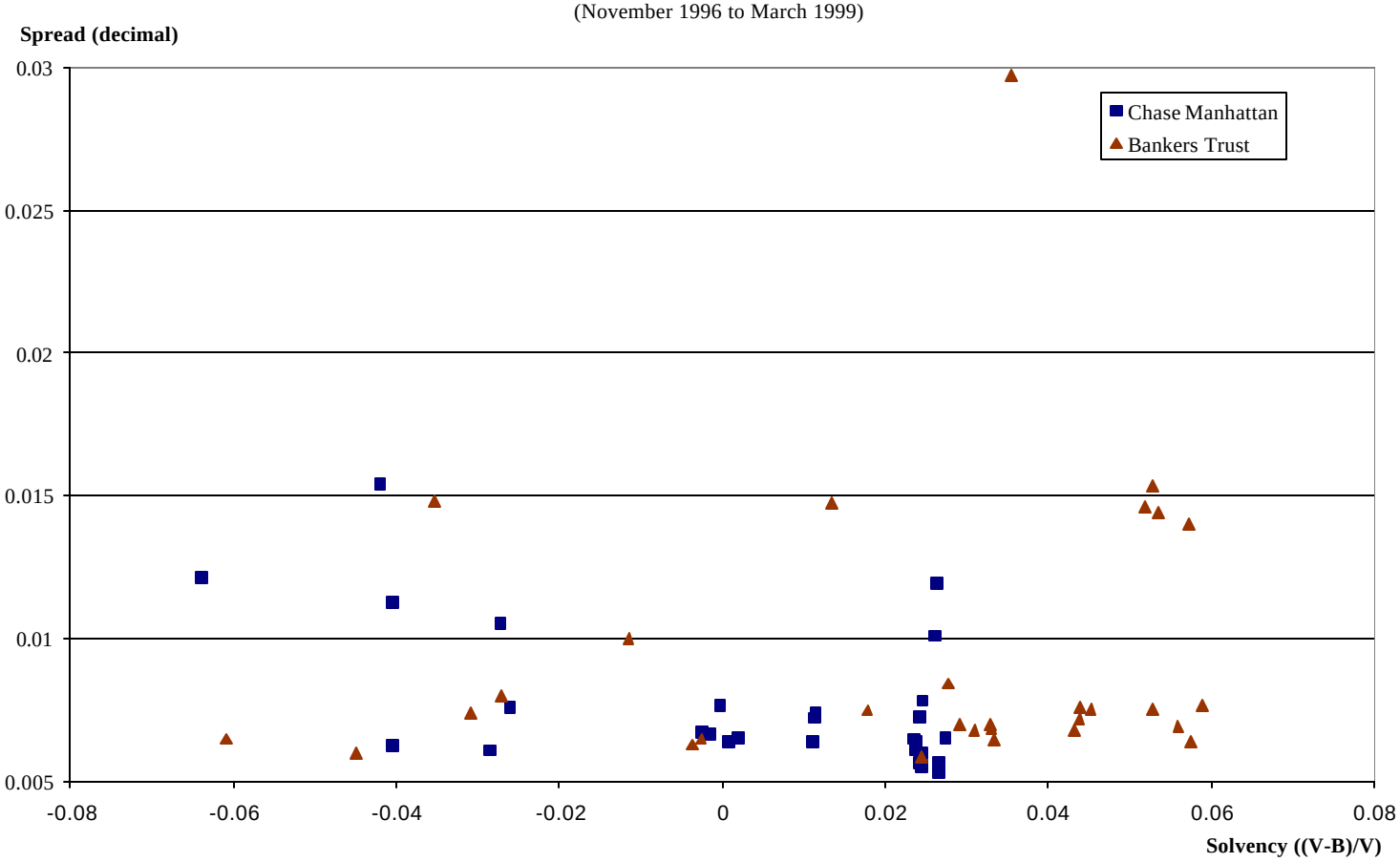
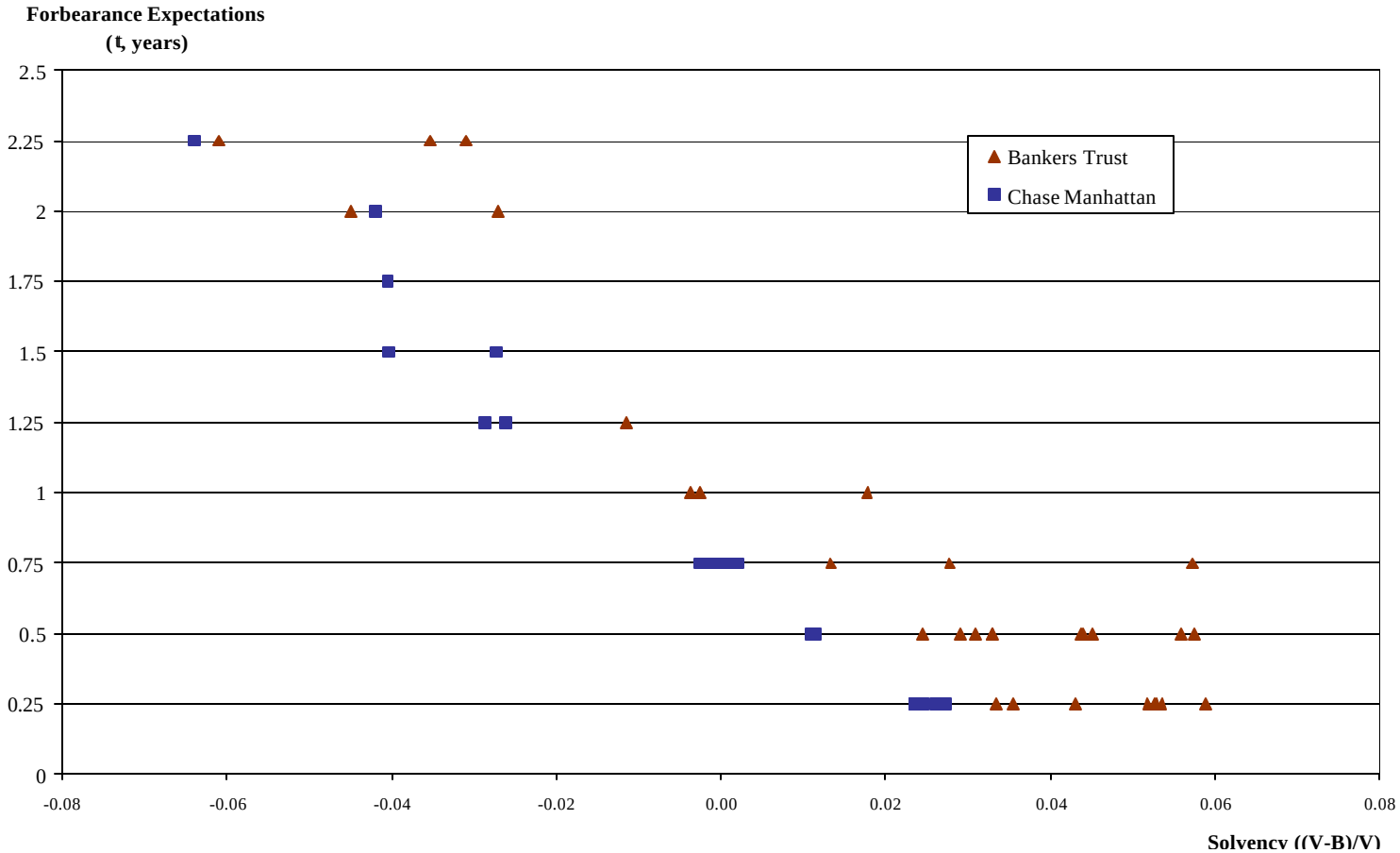


Figure 5

Scatter Plot of Solvency and Estimated Forbearance Expectations (t):
Selected Bank Holding Companies (Bankers Trust and Chase Manhattan)
(November 1996 to March 1999)



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